Form 2800-15
(November 2007)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

RIGHT-OF-WAY NOTICE TO PROCEED

Right-of-Way or Temporary Use Permit (TUP) Serial Number	
NVN 085215	
Date: 03/24/2011	Issuing Office: Stillwater Field Office
Right-of-Way or TUP name: Luning Solar Energy, LLC	

Certified/Registered Mail-Return Receipt Requested

INSTRUCTIONS — Use Certified or Registered Mail or hand deliver. Send or give original to Holder. Distribute other copies as indicated after receipt date.

Holder

In accordance with the terms and conditions of the above referenced right-of-way grant or TUP you are hereby authorized to proceed with the activities noted below in the locations specified. Map(s) are attached. ☐ Yes ☑ No

Activity	Location
Constructin may proceed on the Solar Measurement Station for right-of-way NVN 085215 as specified in the approved plan of development	MDM, T. 8 N., R. 34 E., SW¼SW¼ (within).

Authorized officer is:

Teresa J. Knutson
(Name)

Manager, Stillwater Field Office
(Title)

Onsite inspection and compliance of the Right-of-Way or TUP stipulations will be conducted by the authorized officer's representative.

Erik Pignata
(Name of Authorized Officer's Representative)

5665 Morgan Mill Rd.,
Carson City, NV 89701
(Office, Street Address, City, State, Zip)

775-885-6110
(Office Phone Number)

775-315-2769
(Cell Phone Number)

Charles A Valentine
(Authorized Officer's or Representative's Signature)

3/25/11
(Date)

Acting

Holders Acknowledgement when notice is delivered in person.

(Signature of Recipient)

(Firm Name)

(Name of Recipient)

(Date)

☐ HOLDER ☒ CASE FILE

Lunning Solar Energy, LLC

PLAN OF DEVELOPMENT (POD) for a Solar Measurement Station

Submitted to:

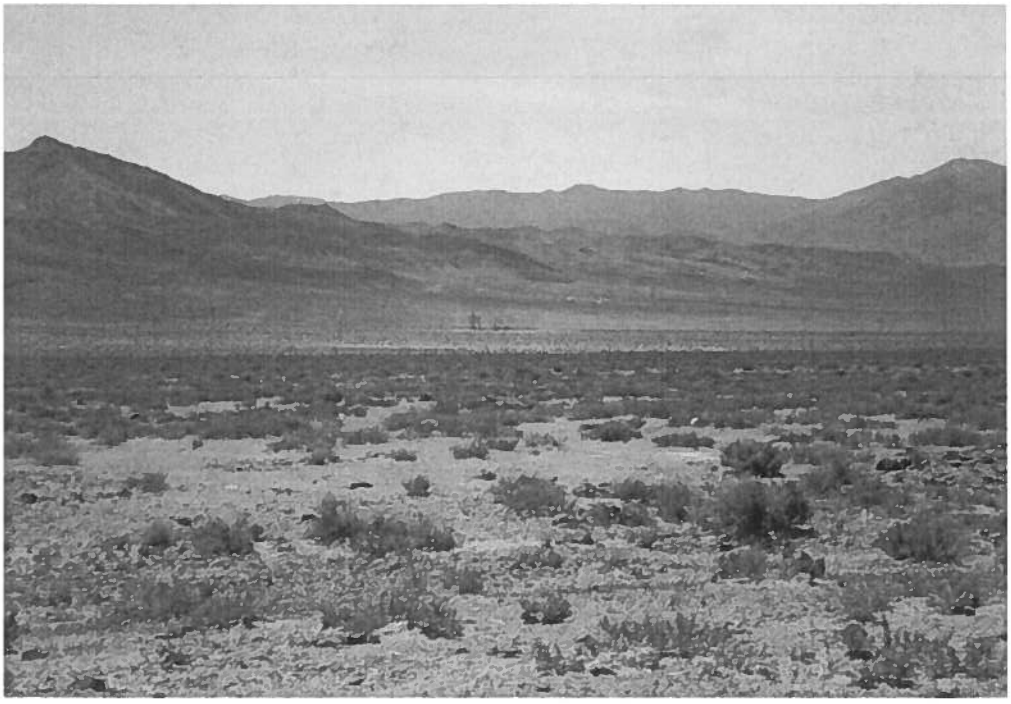
BLM Carson City Field Office

Mr. Erik Pignata

Bureau of Land Management

5665 Morgan Mill Road

Carson City, NV 89701



Submitted By:

AMONIX

POWERING THE FUTURE NOW

Attn: Oksana Hickok

1709 Apollo Court

Seal Beach, CA 90740

Direct: 562.200.7761

Email: Ohickok@amonix.com

www.amonix.com

1. Project Description

This Plan of Development (POD) is submitted to the Bureau of Land Management (BLM) in support of a request allowing a solar measurement station (SMS) to be constructed on land managed by the BLM within the Luning Solar Energy LLC, Right-of-Way Grant NVN 085215 Issued.

This SMS will occupy a 20 foot x 10 foot space to be graded and fenced in adjacent to Hwy 361 on the west side of the highway in Section 15: SW4SW4, T8N, R34E.

a. Introduction:

The purpose is to gather confirmation of the solar resource essential to financing a utility scale solar project pursuant to the ROW Grant. Luning Solar Energy LLC/AMONIX would like to install this SMS during the month of April, 2011.

b. Proponents Purpose and Need for the Project

In order to bid this solar project for an off-take agreement with NV Energy, it is important to provide support data for the electric generation output to be bid. Further, as stated above, collecting at least one year of data is important in gaining financing for a project expected to exceed $100 million.

c. General Facility Description, Design and Operation

- Project Location, land ownership and jurisdiction:

  Proposed location of the SMS: adjacent to the west side of Hwy 361 on the Luning Solar Energy LLC ROW Grant NVN 085215. Exact GPS Coordinates of SMS installation: 38.545756,-118.179774 (Exhibit 1).

- Legal description and total acreage: only about 1/10 of an acre impact for this SMS to occupy a 20 foot x 10 foot space to be graded and fenced in Section 15: SW4SW4, T8N, R34E.

References:

Exhibit 2. General Arrangement
Exhibit 3. Foundation
Exhibit 4. Wind Tower Design
Exhibit 5. Met Station Specifications and General Overview

Generation schematic, roads: N/A; install vehicles will simply drive off Highway 361.

Ancillary facilities: N/A

Water usage: N/A

Erosion control: due to small size, N/A

Vegetation treatment and weed management: N/A

Waste and hazardous materials management: N/A

Fire protection: N/A

Site security and fencing: Solar monitoring station will be enclosed in a 10' x 20' fence anchored to ground with rebar. Fence will be gated with a combination padlock.

Electrical components, new equipment: New components will include a Remote Power Unit, a Kipp and Zonen (manufacturer) Solys2 solar tracker, three solar irradiance measurement instruments, one cellular modem, and four auxiliary weather sensors (wind, relative humidity/temperature, precipitation, and barometric pressure. All are connected to a logger. The logger, barometer, modem, and wiring terminals are located in a secured enclosure mounted on the tracker support structure. The Remote Power Unit is located outside the fence and consists of three solar panels, and two enclosures for four batteries and charge controller. See single-line drawing attached.

Interconnection to electrical grid: N/A

Spill prevention and containment for construction: N/A

Health and safety program: N/A

d. Other Federal, State and Local Agency Permit Requirements: NONE

e. Financial and Technical Capability of Applicant

AMONIX is in the solar technology and development business and has the financial and technical capability to manage this SMS.

2. Construction of Facilities

Select Site and Install Concrete

1. Meet local point of contact
2. Orient team to site safety procedures
3. Conduct Site Survey (Complete site survey checklist) (6.5% Angle)
    a. Shading - use Solar PathFinder at sensor height and note any potential shading of the instrument at the proposed site. Take photos of Solar PathFinder to document shadow risk.
    b. Grade - note grade of the location, estimate percent slope, ensure site selected is flat for the 10' x 20' site footprint
    c. Soil - note soil type for ease of construction
    d. Flooding - note area for washes or evidence of flooding
    e. Access - ensure that the approved route is taken upon entry and exit; note turn by turn directions for site report
    f. Visible from road and vehicle traffic - ideally the instrument site should not be visible from a busy road

g. Aerosols - note distance from road; site should be located away to prevent dust on the instruments
h. Obstructions - note any obstructions (take photos and GPS points)
i. E-mail site survey checklist and photos for client approval?

4. Mark Site
    a. Orient the site to True South
    b. Take GPS point at center of solar base and wind base, record lat/lon
    c. Mark – the 10X20 rectangle
    d. Mark the wind base, solar base, and tipping bucket
    e. Mark the obstruction area, if required
    f. Take photos - take 8 photos from the solar center point at 45 degree increments starting with N
5. If Electricity provided, meet Electrician
    a. Mark Junction Box
6. Install Concrete
    a. Excavate
    b. Build forms, cage, install connection hardware
    c. Verify that orientation matches spec
    d. Pour concrete
    e. Erect first section of mast base while curing

Inventory, Test and Fabricate

1. Receive site specific modem information from Amonix
2. Build/Mount - All sensors (anemometer, temp, rel. hum, barometric, pyranometer(s))
3. Build/Mount – SOLYS2 & Irradiance Sensors
4. Build/Mount - Tipping Bucket
5. Build/Mount - Antenna (ensure brackets to mount to tripod are included)
6. Build/Mount - Cabinet (ensure brackets to mount to tripod are included)
7. Check - for grounding rod & grounding rod clamp
8. Record - All tools used for building/mounting
9. Scan all calibration certificates
10. Calibrate - Tipping Bucket
11. Wire - All sensors (irradiance, anemometer (direction & speed), temp, rel. hum, barometric, pyranometer(s), tipping bucket)
12. Install - Program onto logger
13. Install – Program onto modem
14. Test - All sensors (anemometer (direction & speed), temp, rel. hum, barometric, pyranometer(s), tipping bucket)
15. Test - Communications
16. Test - Charging system
17. Test - Data capture (auto, remote, on-site)
18. Pack - re-pack all sensors and materials
19. Purchase additional hardware

20. Fabricate remote power unit

Install SMS

1. Solar Base
    a. Install Solar Base
    b. Install SOLYS2, and solar sensor subsystem
    c. Ethernet from SOLYS2 to CR1000
    d. Power from SOLYS2 to PDB
    e. Power from Ventilators to PDB
    f. Solar sensors to CR1000
2. Install Logger
3. Install Power
4. Mount Logger Enclosure
5. Wind Base
    a. Layout Mast
    b. Install Wind Sensor, Orient Wind Vane
    c. Install Antenna
    d. Lift Mast
6. Tipping Bucket Base
    a. Install Tipping Bucket Stake
    b. Install RH/Temp Sensor
    c. Install Tipping Bucket
7. Cable System
    a. Conduit from Wind Base to Solar Base
    b. Conduit from Tipping Bucket Base to Solar Base
8. Connect sensors to logger (follow wiring diagram)
9. Clean
10. Onsite QA/QC
11. Lock

Install Available Power

1. Run Conduit from Junction Box
2. Install Power Distribution Box
3. Mount on Solar Base
4. Connect SOLYS2, Ventilators, Logger
5. Test function

Install Remote Power

1. Deploy remote power unit
2. Run Conduit to PDB

    a. SMS and timetable: it requires 4 men 10 days to install, ideally to be installed late April or early May, 2011.
    b. Phased project: N/A

c. Access: access is excellent as the site is on Hwy 361.
d. Construction work force: At any given time there will be 2 vehicles at most on site and 2 to 4 workers. The entire process will take 3 full days (non consecutive).

3. Related Facilities and Systems (This is a data collection equipment to facilitate subsequent construction of a solar energy facility)

e. Transmission and proposed transmission: N/A at this time.
f. Gas Supply System: None.

4. Operations and Maintenance

The site will be visited twice weekly by a trained local technician. The local technician will perform cleaning duties including the use of distilled water, as well as leveling the instruments and ensuring the security of the station. These visits will last 20-30 minutes in duration.

5. Environmental Considerations

a. None that we know of other than visual impact.
Special or sensitive species and habitats
- Special land use designations
- Cultural and historic resource sites and values
- Native American Tribal concerns
- Recreation and OHV conflicts
- Other environmental considerations

These issues for this location have been address in the Environmental Assessment prepared for the entire ROW site. Please reference the Cultural Survey to confirm if there would not be any avoidance issues in the chosen location for this Solar Measurement System.

b. Mitigation: All the major equipment pieces are rather easily removed. Given the relatively small size, these are easily picked up with a small loader and placed on a flatbed.

6. Maps and Drawings

Exhibit 6.Single Line Drawings.

EXHIBIT 1

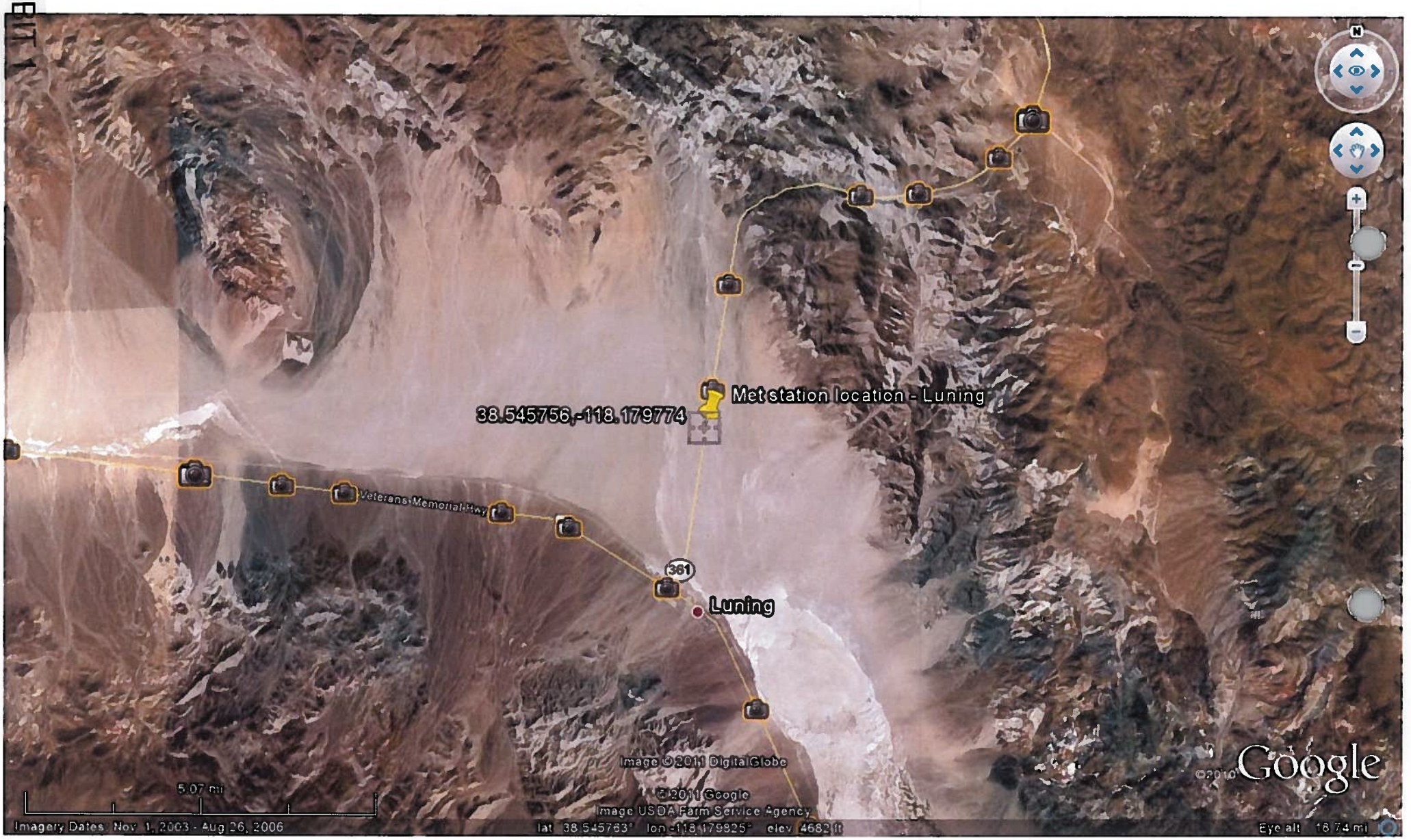
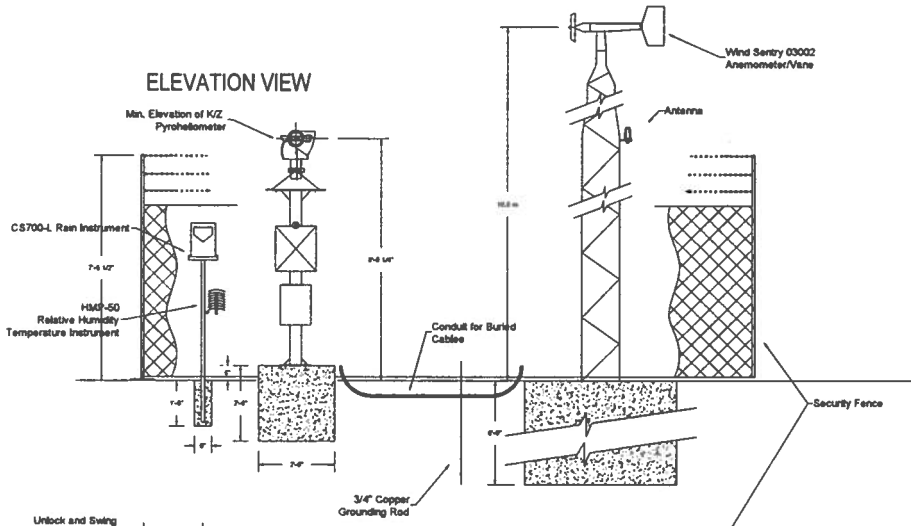
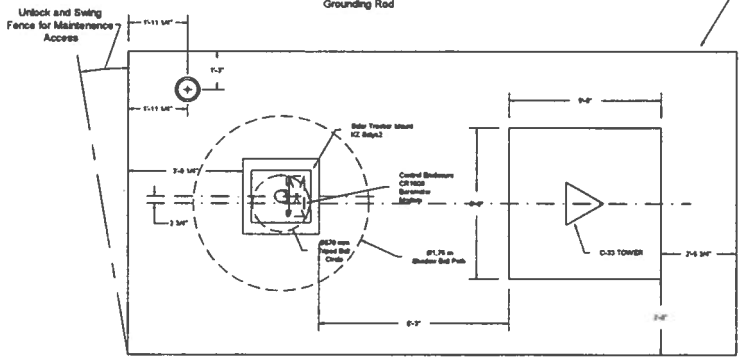

Met station location - Luning
38.545756,-118.179774
Veterans Memorial Hwy
361
Luning
Image © 2011 DigitalGlobe
© 2011 Google
Image USDA Farm Service Agency
5.07 mi
Imagery Dates: Nov 1, 2003 - Aug 26, 2006
lat 38.545763° lon -118.179825° elev 4682 ft
Eye alt 18.74 mi
Google

EXHIBIT 2





PLAN VIEW

NOTES:
1. Antenna is mounted above top of fence.

2. Copper ground is 6' and must be buried a minimum of 5'-6".

3. Cables connecting 3 meter mast and control enclosure are buried to prevent trip hazard.

4. Rain Instrument is mounted on 1" Sched. 40 galvanized pipe in concrete filled post-hole.

N

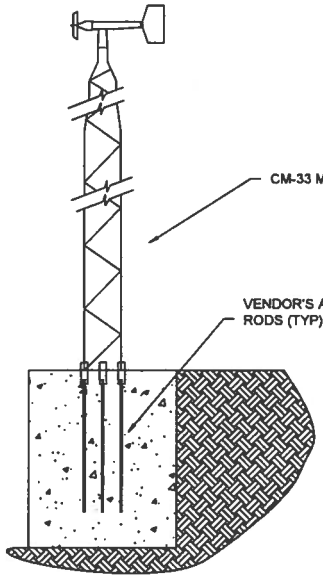
Required Cable Lengths			
	model	feet	notes
Wind	03002-LXX-PT	60	repl/ext required
Antenna	TRAB821-18503P	30	repl/ext required
Rain	CS700-L10	10	mod position inst
RH/T	HMP50-L10-PT	10	mod position inst

Rev B	Modified for seismic/wind	04/21/2010	GroundWork Renewables, Inc.	B	10023GA2	C

AMONIX

SOLAR MEASUREMENT STATION
GENERAL ARRANGEMENT

EXHIBIT 3



SECTION A - A

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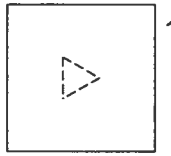
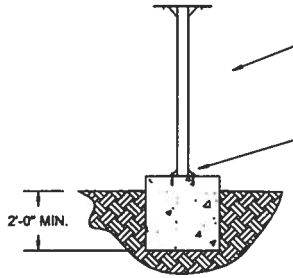


PLAN

NO SCALE



SECTION B - B

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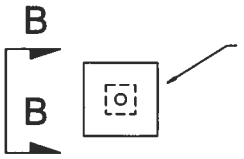


PLAN

NO SCALE

Notes:

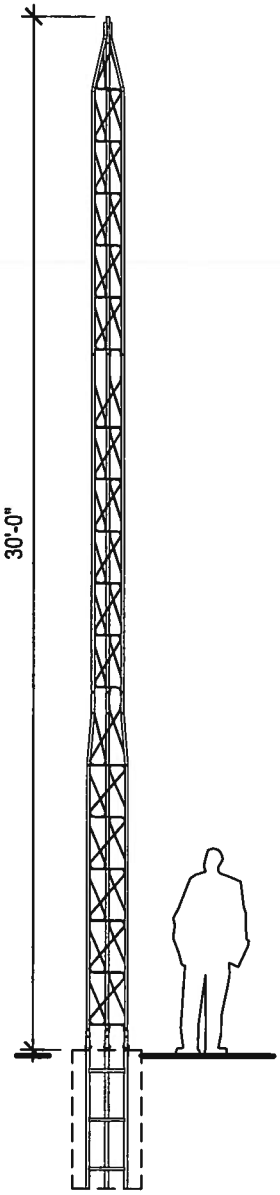
1. Grounding Kit installed per vendor instructions and manufacturer's dwg. no. 100924 Rev L.

2. C-33 tower base and anchoring system installed per manfuacturer's instructions.

Rev 0	For Construction	05/04/2010	GroundWork Renewables, Inc.	CLIENT: AMONIX			
				TITLE: SOLAR MEASUREMENT STATION STRUCTURE FOUNDATIONS			
				SIZE: A	DATE: 04/21/2010	DWG NO: 1002CV01	REV: 0
				SCALE: NA		SHEET: 1/1	

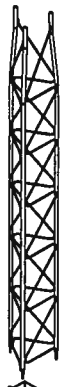
FREESTANDING ALUMINUM TOWER

MODEL #4-30

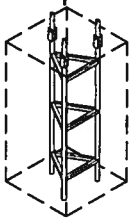


11TOP

11-STRT



14-TAPR



B-14

TOTAL WEIGHT: 38 LBS.

WIND LOADING:

80 mph	4.5 Sq. Ft.
100 mph	2.5 Sq. Ft.
110 mph	1.5 Sq. Ft.

Contact Universal Towers to confirm geographical location of your tower and all wind load implications

WARRANTY

UNIVERSAL TOWERS ARE WARRANTED AGAINST DEFECTIVE MATERIAL OR WORKMANSHIP AND ARE SUBJECT TO REPAIR OR TO MATERIAL REPLACEMENT ONLY IF FAILURE RESULTS FROM THESE FACTORS WITHIN ONE YEAR FROM PURCHASE BY USER. THIS WARRANTY DOES NOT EXTEND TO ANY OF OUR PRODUCTS WHICH HAVE BEEN SUBJECTED TO MISUSE, NEGLECT, ACCIDENT, IMPROPER INSTALLATION OR APPLICATION, NOR SHALL IT EXTEND TO UNITS WHICH HAVE BEEN REPAIRED OR SUBSTANTIALLY ALTERED OUTSIDE OF OUR FACTORY. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED.

ELEVATION 2
SCALE: 3/16"=1'-0"

ISOMETRIC 1
SCALE: N.T.S.

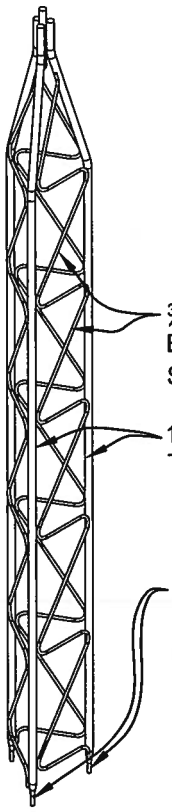
ALUMINUM TOWER

EXHIBIT 4

UNIVERSAL TOWERS
A DIVISION OF
UNIVERSAL MANUFACTURING CORP.
43900 GROESBECK HWY.
CLINTON TOWNSHIP, MI 48036
PH: (586) 463-2560
FAX: (586) 463-2964

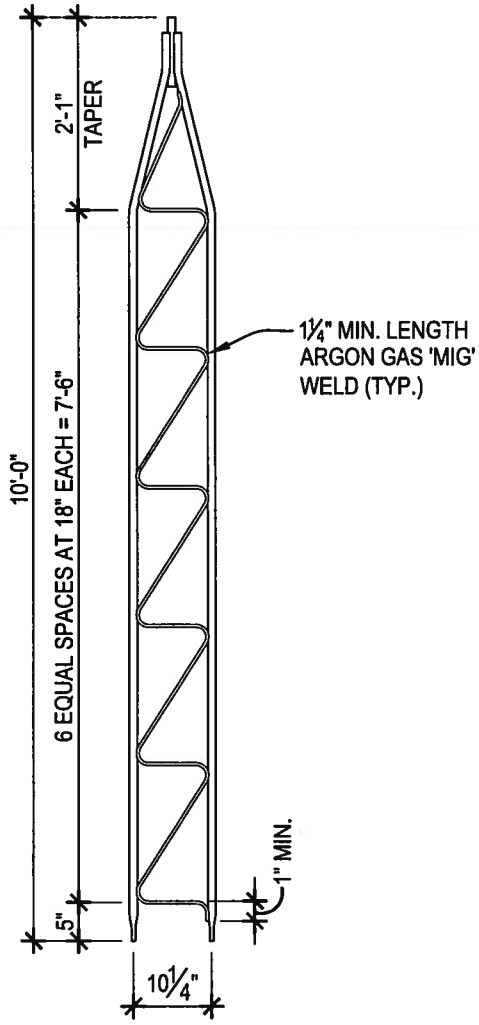
JOB NO.:

COMPONENT:
4-30



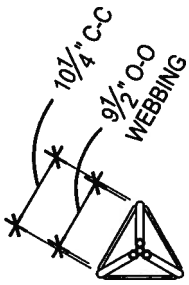
ISOMETRIC 3

SCALE: N.T.S.



ELEVATION 2

SCALE: 1/2"=1'-0"



PLAN VIEW 1

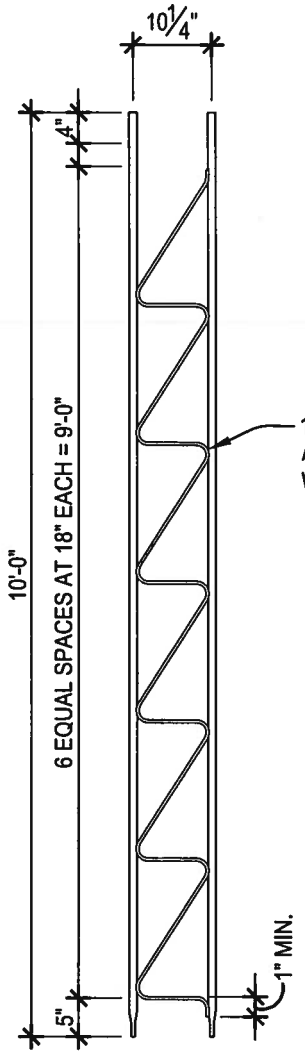
SCALE: 1/2"=1'-0"

TOP SECTION

UNIVERSAL TOWERS
A DIVISION OF
UNIVERSAL MANUFACTURING CORP.
43900 GROESBECK HWY.
CLINTON TOWNSHIP, MI 48036
PH: (586) 463-2560
FAX: (586) 463-2964

JOB NO.:

COMPONENT:
11-TOP



ELEVATION 2

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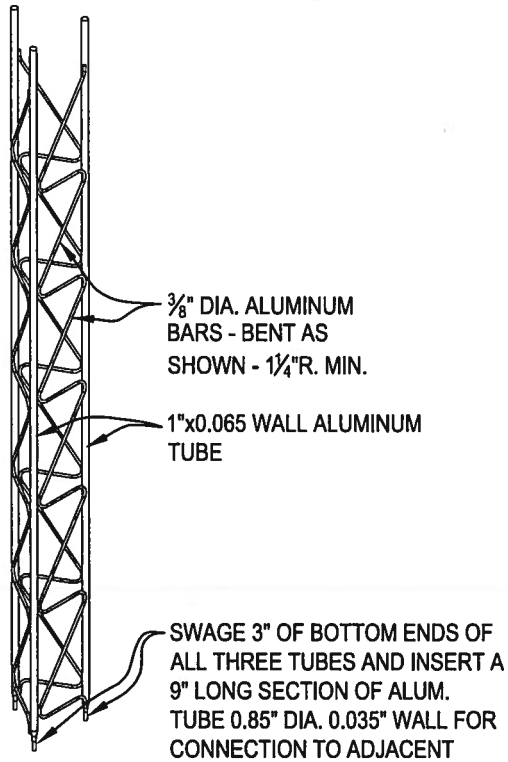

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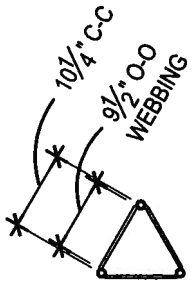


PLAN VIEW 1

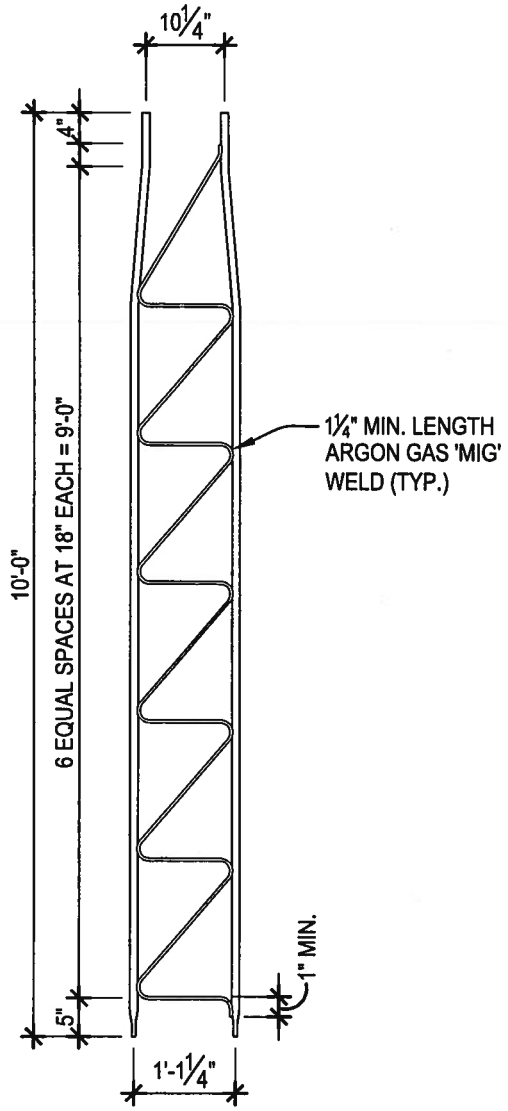
SCALE: 1/2"=1'-0"

STRAIGHT SECTION

UNIVERSAL TOWERS
A DIVISION OF
UNIVERSAL MANUFACTURING CORP.
43900 GROESBECK HWY.
CLINTON TOWNSHIP, MI 48036
PH: (586) 463-2560
FAX: (586) 463-2964

JOB NO.:

COMPONENT:
11-STRT



ELEVATION 2

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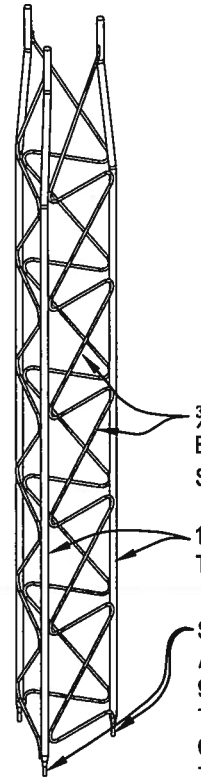

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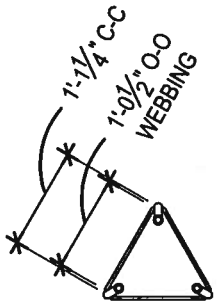


PLAN VIEW 1

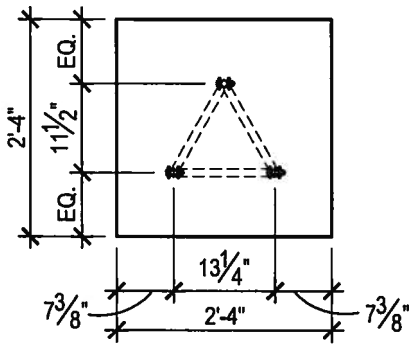
SCALE: 1/2"=1'-0"

TAPERED SECTION

UNIVERSAL TOWERS
A DIVISION OF
UNIVERSAL MANUFACTURING CORP.
43900 GROESBECK HWY.
CLINTON TOWNSHIP, MI 48036
PH: (586) 463-2560
FAX: (586) 463-2964

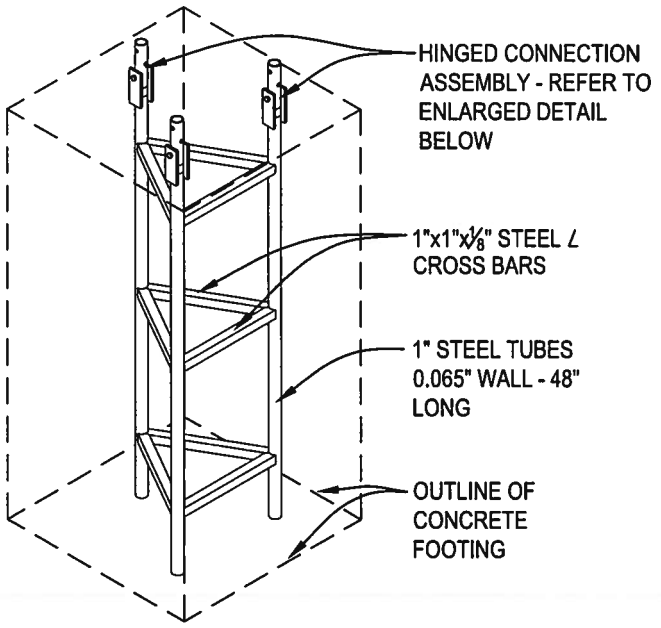
JOB NO.:

COMPONENT:
14-TAPR



PLAN VIEW 1

SCALE: 1/2"=1'-0"



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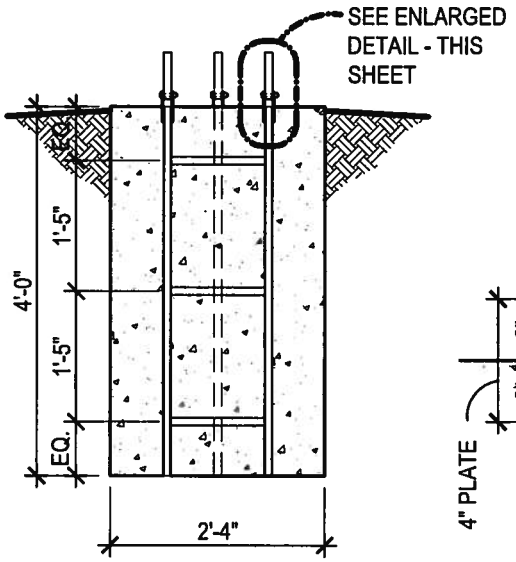
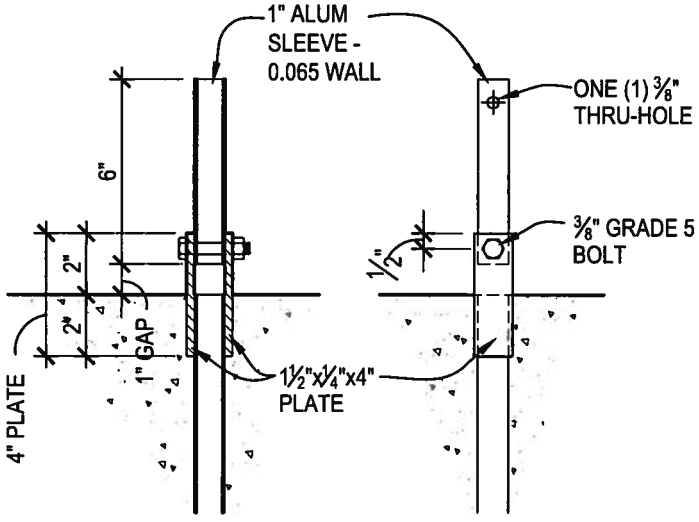




ELEVATION 2

SCALE: 1/2"=1'-0"

NOTE: FOUNDATIONS ARE DESIGNED FOR FIRM BEARING SOIL.

BASE FOOTING

UNIVERSAL TOWERS
A DIVISION OF
UNIVERSAL MANUFACTURING CORP.
43900 GROESBECK HWY.
CLINTON TOWNSHIP, MI 48036
PH: (586) 463-2560
FAX: (586) 463-2964

JOB NO.:

COMPONENT:
B-14

Solar Resource and Meteorological Assessment Project (SOLRMAP)
Solar and Meteorological Station Options:
Configurations and Specifications

December 12, 2008 (revised)
Steve Wilcox and Tom Stoffel
National Renewable Energy Laboratory

Purpose

This document provides guidance for standard measurement system configurations to produce solar resource information consistent with accuracy requirements for site-specific resource assessment and/or installed power system performance validation. The measured data will also be used for improving satellite-based modeling of solar radiation and for validation of solar resource forecasting methods. The configurations listed present a range of instrument accuracies from which to choose for the fundamental measurements as well as information necessary for data validation.

In support of the Solar Technologies Program, NREL will provide expert advice and assistance on configuring, installing and operating commercially available equipment for a solar radiation measurement station. Additionally, NREL will provide expert data analysis, including data quality assessment, archive the data and provide access to the historical and nearly real-time data via the internet through the Measurement & Instrumentation Data Center (http://www.nrel.gov/midc).

Background

Accurate site-specific measurements of solar radiation resources are important for the design of solar energy conversion systems and for assessing installed system performance. Measuring the electrical output of a solar power plant is a fairly straightforward effort and can be accomplished with high accuracy. However, evaluating the efficiency of renewable energy conversion requires knowledge of the solar energy incoming to the plant as measured with commercially available radiometers with varying accuracies.

Estimates of historical (1991 – 2005) hourly solar irradiance from satellite-based cloud imagery and surface cloud observations have been used to produce the National Solar Radiation Database Update (NSRDB) [http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/]. A limited amount of accurate measurements of solar irradiance were used to validate these models. Measurements from additional locations are needed to develop improved models and address research needs for developing solar radiation forecast methods.

High quality instruments are available from various manufacturers. Price estimates from three manufacturers are included here for instruments with which we have experience. *This list does not constitute an endorsement, nor does it preclude the selection and use of equipment from other manufacturers.* However, equipment not listed here may be incompatible with the NREL calibration procedures or data acquisition and distribution infrastructure. The prices listed here are approximate and based on manufacturer's price lists. Firm and final pricing is available by quote from the manufacturers.

EXHIBIT 5

Equipment

Two basic instrument packages are described below for making site-specific solar resource measurements or for instrumenting a solar energy conversion power plant to support operational needs for system performance and/or solar resource forecasting. The two configurations offer a range of measurement uncertainty and maintenance requirements. Each configuration provides sub-hourly data for the direct normal irradiance (DNI), diffuse (DIFF) irradiance, and the global horizontal (GH) irradiance, as well as ambient air temperature (TEMP), wind speed (WS) and direction (WD), and relative humidity (RH). Additional instrumentation can be added as required for site-specific applications, e.g., plane-of-array (POA) irradiance, barometric pressure (BP), and/or precipitation (PRECIP). The estimates below do not include infrastructure costs, such as underlying support surfaces or structures, electrical power, telephone/internet connectivity, etc.

Both configurations require a location for the instruments that provides good daily solar access throughout the year. This should be an area with a clear horizon without any obstructions that might shade the instruments or introduce reflected solar radiation (for instance, a building roof is often a good location). But the location should also have safe and secure access, which is required for regular equipment inspections.

Equipment spares are recommended to provide replacement due to failure and/or calibration, especially for the radiometers. Please consult with the manufacturer or NREL to determine the optimum types and quantity of equipment spares.

A total sky imager can supplement the data recorded from either recommended configuration. This all-weather instrument provides sky images and cloud amounts important for interpreting the coincident solar radiation and meteorological data. (See http://www.yesinc.com/products/cloud.html or http://www.nrel.gov/midc/srrl_bms/)

Configuration 1 – Silicon Photodiode Radiometers – Lower Cost / Lower Maintenance / Higher Measurement Uncertainty Potential

This lower-cost option provides solar measurements adequate for many applications and also requires a lesser amount of maintenance. The Rotating Shadowband Radiometer (RSR) system design is based on the fast response (10 µsec) of the silicon photodiode detector used in the pyranometer. The RSR system includes a data logger that provides additional input channels for optional sensors. The base configuration includes measurements for temperature, humidity, wind speed, and wind direction. The communications interface is a telephone modem (optional internet connectivity is highly desirable to allow for more frequent data access and display). This system is self-powered via photovoltaic panels and is desirable for use in areas without reliable grid electrical power. Instrumentation, measurement parameters, equipment purchase price, installation labor, and estimated measurement uncertainties for Configuration 1 are summarized in Table 1. Typical RSR installations are shown in Figure 1.

Figure 1. RSR installations at NREL (Left) and at Pueblo, Colorado (Right).

Table 1. Equipment Configuration 1 – Lower Cost / Lower Maintenance / Higher Measurement Uncertainty Potential

	Instrument	Data Parameter(s)	Purchase Price	Installation (Person-Hrs)	Data Uncertainty*	
					Bias (mean deviation)	Random (std deviation)
Baseline Configuration	Rotating Shadowband Radiometer System (Irradiance, Inc Model RSR2	Measured GH and DIFF irradiances. Computed DNI. Includes secondary sensor, CR800 data logger with air temperature and gill shield.	$9,100	4	-3.5 to -7.5% DNI +1.0 to -1.2% GH +3.0 to -0.2% DIF	16 to 19%† 4 to 6% 5 to 6%
	Mounting Method	• Simple pipe for flat surface (e.g. concrete pile) • Ballast plate for flat surface (e.g., roof) • Tripod for ground mounting (e.g., desert floor)	$95 $185 $575	4	N/A	N/A
	Choose Power Supply (as needed)	10-watt module, charge controller and battery for high insolation (>3 kWh/m^2 day average during minimum month) 20-watt module, charge controller and battery (>2 kWh/m^2/day minimum)	$500 $700	N/A	N/A	N/A
	Temperature and Relative Humidity	Campbell CS 215	$535	1	±0.2° temp ±2% RH	Not evaluated
	Barometric Pressure	CS106	$885	1	±1 mbar	Not evaluated
	Wind	03001-L RM Young WS/WD set with supporting 10 ft mast	$1050	2	±5° WD ±1.5% WS	Not evaluated
	Communications	Telephone wired modem	$550	N/A	N/A	N/A
Optional Upgrades	Licor LI-200 pyranometer (optional)	POA for fixed tilt collector	$270	2	+2.8 to -2.0%	3 to 8%
	Texas Electronics Tipping Bucket (Campbell p/n TE525-20)	PRECIP	$615	3	± 0.01"	Not evaluated
	Communications Upgrades	Ethernet (hard wired) Ethernet (cellular gprs/edge)	$640 $1125	N/A	N/A	N/A
	Data logger upgrade to Campbell CR-1000	Required for meteorological instruments and optional solar instruments	$700	N/A	N./A	N/A
	Total	Minimal configuration With all options	$12,620 $15,555	12 17		

* Estimated measurement uncertainty *for sub-hourly data intervals* over a wide range of zenith angles, based on annual instrument calibrations traceable to national and international measurement standards and other NREL evaluations. Assumes proper equipment installation and regular maintenance at two to three times per week. Radiometer uncertainty ranges account for spectral irradiance variations due to changes in atmospheric conditions. Uncertainties for daily, monthly, or annual means may be less. Radiometer uncertainties do not include data logging uncertainties.

† High random error may be exaggerated due to slower response of reference thermopile instruments (10 µsec vs. 1 sec)

Configuration 2 – Thermopile Radiometers – Higher Cost / Higher Maintenance / Lower Measurement Uncertainty Potential

This option, while of greater cost for both equipment acquisition and on-going maintenance, provides the lowest uncertainty measurements of global, direct beam, and diffuse solar irradiance. This configuration is recommended for operators requiring the best possible solar resource measurements for assessing power plant performance.

While a specific application may not require all three of the recommended solar components, one critical advantage of this option is the ability to maintain much tighter controls on data quality assessment through redundant measurements. That is, data quality tests include checks of internal consistency based upon:

$$GH = DNI * \cos(Z) + DIFF$$

where, Z = solar zenith angle for the time of measurement.

Thus, removing one or more of the solar components that do not directly support a particular application will result in a much higher post-measurement uncertainty.

This system requires reliable electrical power or an adequate uninterruptible power supply such that electricity can be maintained without interruption for many weeks. A stand-alone PV system rated for at least 600 Watts with battery storage has been used successfully for this purpose. A site specific analysis should be done if PV power is required.

Maintenance for this option is more critical than Configuration 1. Daily instrument cleaning and tracker alignment checks are necessary to maintain the lower measurement uncertainty potential for this option. Routine preventative maintenance can be accomplished in about 15 minutes per visit. Corrective maintenance (e.g., solar tracker failure) can require several hours. Without a commitment to this ongoing maintenance schedule, much of the advantage afforded by higher instrumentation cost will be lost. Instrumentation, measurement parameters, equipment purchase price, installation labor, and estimated measurement uncertainties for Configuration 2 are summarized in Table 2. The system installation used for the DOE Atmospheric Radiation Measurement Program is shown in Figure 2 (see also http://www.arm.gov/about).

Maintenance

Proper operations and maintenance of the measurement system is critical for the production of accurate solar resource data.

Measuring solar radiation requires clean optics to prevent attenuation of the solar signal that reaches the instrument sensor and accurate solar tracking for proper alignment of instruments with the solar disk. Site operators will be responsible for maintaining the instrumentation as required by the application.

Studies have shown that the instrumentation in Configuration 1 is less prone to soiling from environmental conditions than that specified in Configuration 2 (see http://www.nrel.gov/docs/fy99osti/25374.pdf, section 8.3). The recommended interval for cleaning instruments in Configuration 1 is two to three times a week, depending on weather conditions, whereas *daily maintenance* is required for Configuration 2 to fully exploit the reduced uncertainty of the instruments. NREL has developed real-time data quality control test methods that can be used to alert

the station operator of suspected equipment problems. On-site maintenance needs for either configuration are summarized in Table 3. A permanent record of maintenance activities is a critical tool for evaluating the quality of the measured data (see http://www.nrel.gov/midc/apps/maint.pl?BMS).

Data processing/analysis

NREL may provide expert analysis and quality checks for all data. Data may be acquired in near-real time (depending on internet connectivity at the station location) and analyzed for quality.
NREL may provide easy internet access to sanctioned data sets in a standard format. Data may appear on an NREL web site, similar to this (data from the Nevada Power Clark Station):
http://www.nrel.gov/midc/npcs/

Special access limitations can be provided for proprietary data sets. To help maintain the greatest potential for the site operator's investment, NREL may also fund data analysis, distribution costs and provide expertise as required to understand and interpret the data.

Figure 2. Unshaded pyranometer (Left) for GH measurement, shaded pyranometer and pyrgeometer (on solar tracker horizontal platform) for DIFF and downwelling longwave (infrared – for atmospheric science study), and pyrheliometer (on sided of solar tracker) for DNI measurements at the DOE/ARM Southern Great Plains station near Lamont, Oklahoma.

Table 2. Equipment Configuration 2 – Higher Cost / Higher Maintenance / Lower Measurement Uncertainty Potential

	Instrument	Data Parameter(s) / comments	Purchase Price	Installation (Person-Hrs)	Data Uncertainty*	
					Bias (mean deviation)	Random (std deviation)
Baseline Configuration	**Pyrheliometer** Eppley Model NIP	DNI	$2,350[1]	2	+0.46 to -0.53%	0.4 to 0.6%
	Kipp & Zonen Model CH1		$3,500[2]		+0.23 to +0.1%	0.4 to 0.5%
	Ventilated Pyranometer Eppley Model PSP w/VEN ventilator	GH	$3,200[1]	6	+1.6 to -11.3%	2 to 8%
	Kipp & Zonen Model CM22 w/CV-2 Ventilator and CVP-2 Power supply		$9,016[2]		+0.6 to +0.4%	2 to 3%
	Ventilated Pyranometer Eppley Model 8-48 w/VEN ventilator	DIFF	$2,475[1]	6	±5% of reading or 10 W/m^2	±3W/m^2
	Kipp & Zonen Model CM22 w/CV-2 ventilator and CVP-2 Power supply		$9,016[2]		±2% of reading or 5 W/m^2	±3W/m^2
	Automatic Solar Tracker Eppley SMT-3	(Radiometers and ventilators installed on solar tracker. Includes tripod or mount†, shade mechanism, and other accessories.)	$18,975[1]†	4	<0.1° (1/50 5°FOV)	±0.02° (1/250 5°FOV)
	Kipp & Zonen Model 2AP-GD		$29,350[2]		<0.05° (1/100 5°FOV)	±0.01° (1/500 5°FOV)
	Meteorological Tower Campbell Scientific CM10 10 ft steel tripod tower	(Tripod 10 ft tower supports data logger and meteorological instruments:	$450	4	N/A	N/A
	ENC12/14 Enclosure for logger		$205			

	Meteorological Instruments Vaisala HMP-50C Temp & RH Campbel 41003-5 Radiation Shield 03001-L RM Young WS/WD set	Co-located meteorological measurements of air temperature, relative humidity, wind speed, and wind direction	$400 $120 $650	2	N/A	N/A
	Data Logger Campbell Scientific, Inc. Model CR1000	Programmable control and data acquisition system. Includes extended temperature range and 4MB memory	$1,640	6	(OFFSET) 22µV (~2-3 Wm^{-2} at 7 µV/W)	4.2 µV (~ 0.5 Wm^{-2} at 7 µV/W)
	Telephone Modem Campbell Scientific, Inc. Model COMM220	(Access data logger recordings by land line)	$400	2	N/A	N/A
	Miscellaneous	Cabling, connectors, conduit, hardware, etc.	$400	3	N/A	N/A
Optional Upgrades	**Network Link Interface** Campbell Scientific, Inc. Model NL100	(Access data logger recordings by internet connection to NREL/MIDC)	$500	2	N/A	N/A
	Ventilated Pyranometer Eppley Model PSP w/VEN ventilator Kipp & Zonen Model CM22 w/CV-2 Ventilator and CVP-2 Power supply	POA for tracking flat plate collector	$3,200[1] $9,016[2]	2	±1.6% ‡ ±0.6%‡	2 to 3% 2 to 3%
	Ventilated Pyranometer Eppley Model PSP w/VEN ventilator Kipp & Zonen Model CM22 w/CV-2 Ventilator and CVP-2 Power supply	POA for fixed tilt collector	$3,200[1] $9,016[2]	2	+1.6 to -11.3% +0.6 to +0.4%	2 to 8% 2 to 3%
	Barometer Vaisala CS106	BP	$590	1	±1 mbar	Not evaluated
Total	**Base system** **With all options**		$31,265[1] $55,147[2] $38,355[1] $73,869[2]	45 52	N/A	

[1] Eppley Configuration
[2] Kipp & Zonen Configuration
†SmartTracker estimate includes $800 allowance for tripod or mounting fixture, not supplied by Eppley
* Estimated measurement uncertainty for *sub-hourly data intervals* over a wide range of zenith angles based on annual instrument calibrations traceable to national and international measurement standards and other NREL evaluations. Assumes proper equipment installation and regular daily maintenance. Uncertainties for daily, monthly, or annual means may be less. Radiometer uncertainties do not include data logging uncertainties.
‡ Uncertainties for tracking plane of array radiometers assume a limited range of solar incident angles

Table 3. Maintenance Items

Item	Comments	Approximate Time*
Cleaning and inspection	Radiometer optics require cleaning using distilled water and a clean, lint-free cloth. Minimal training and expertise are necessary, but a commitment to quality and thoroughness is required.	5-10 minutes
Tracker alignment check	Configuration 1: Confirm shading band rotation is occurring on time (2/minute). Configuration 2: The tracker is software controlled and does not require regular maintenance. Proper operation can be quickly ascertained visually through the use of the built-in alignment target.	2 minutes
On-site troubleshooting	Assistance may be required for on-site troubleshooting by NREL for identified equipment problems as they occur. This may involve an instrument swap for difficult failures.	Highly variable – average of 1-2 hours per month.
Annual calibration swaps	Remove/replace radiometers during recalibration at NREL.	Four hours per year
Weather Observation	During maintenance, the operator can record cloud amount and other weather conditions relevant to interpreting the measured data.	5 minutes

* Time estimates exclude travel to/from the equipment location.

Data Uses

Developers can use the data for site resource analysis and to support site evaluations in conjunction with other large-scale solar resource databases. Plant operators can use the data sets for analysis of plant operations and conversion efficiencies. NREL will use the data for on-going research, including refinement of the long term solar resource and its variability at the site, advancing model development for direct normal irradiance using satellite imagery, and for validating solar resource forecasting methods currently under development.

Educational Cooperatives

Where feasible and compliant with the needs or restrictions of power plant operators, NREL will encourage collaboration with nearby education institutions to involve students in measurement station operations. Students could be engaged to perform station maintenance (visiting the site to clean instruments and check operations in lieu of plant personnel) and to use the data for collaborative research involving the power plant operator and NREL.

Radiometer Manufacturers & Distributors

Analytical Spectral Devices, Inc.
5335 Sterling Drive, Suite A
Boulder, CO 80301
Telephone: (303) 444-6522
Telefax: (303) 444-6852
http://www.asdi.com
Spectral Irradiance Measurements

Brusag
Chapfwiesenstrasse 14
CH-8712 Stäfa
Switzerland
Telephone: +41 1 926 74 74
Telefax: +41 1 926 73 34
Automatic Solar Trackers

Campbell Scientific, Inc.
815 West 1800 North
Logan, Utah USA 84321-1784
Telephone: 435.753.2342 (Info)
Telephone: 435.750.9681 (Orders)
Telefax: 435.750.9540
Email: info@campbellsci.com
http:// www.campbellsci.com
Data Logger Systems & Weather Stations

Casella London Limited
Regent House
Britannia Walk
London N1 7ND
Telephone: 01-253-8581
Telex: 26 16 41
Radiometers

Davis Instruments, Corp.
3465 Diablo Ave.
Hayward, CA 94545, USA
Telephone: (510) 732 9229
Telefax: (510) 670 0589
http://www.davisnet.com
Weather Stations

DAYSTAR
3250 Majestic Ridge
Las Cruces, NM 88011
Telephone: (505) 522-4943
http://www.raydec.com/daystar
Radiometers

Delta-T Devices Ltd
130 Low Road, Burwell
Cambridge, CB25 0EJ
UK
Radiometers, Weather Stations and Data Loggers
U.S. Distributor:
Gary L. Woods, Sales Manager
garywoods@dynamax.com
www.dynamax.com
800-896-7108 - Toll Free
281-564-5100
281-564-5200 - Fax

EKO Instruments Trading Co., LTD.
21-8
Hatagaya 1-chome
Shibuyaku, Tokyo 151
Japan
Telephone: 81-3-3469-4511
Telefax: 81-3-3469-4593
Telex: J25364 EKOTRA
http://www.eko.co.jp/eko/english/03/a.html
Radiometers, Trackers, Data Loggers
U.S. Distributor:
SC-International, Inc.
346 W. Pine Valley Drive
Phoenix, AZ 85023
Telephone: (602) 993-7877
Telefax: (602) 789-6616

The Eppley Laboratory, Inc.
12 Sheffield Avenue
Newport, RI 02840
Telephone: (401) 847-1020
Telefax: (401) 847-1031
http://www.eppleylab.com/
Radiometers, Trackers, Data Loggers

(Continues)

Hukseflux Thermal Sensors B.V.
Elektronicaweg 25
2628 XG Delft
The Netherlands
Telephone: +31-15-2142669
Fax: +31-152574949
Radiometers

Hukseflux U.S. Sales Representative
Robert Dolce
HukseefluxUSA
P.O. Box 850
Manorville, NY 11949
631-251-6963
E-mail: rdolce@HukseefluxUSA.com

Irradiance. Inc.
41 Laurel Drive
Lincoln, MA 01773 USA
Phone/Fax (781) 259-1134
http://www.irradiance.com/rsr.html
Rotating Shadowband Radiometer (RSR)

Kipp & Zonen, Delft BV
P.O. Box 507
2600 AM Delft Holland
Mercuriusweg 1
2624 BC Delft Holland
Telephone: 015-561 000
Telfax: 015-620351
Telex: 38137
http://www.kippzonen.com
Radiometers, Trackers, Data Loggers

US Sales Representative for K&Z:
Joan Flamino
Kipp & Zonen
125 Wilbur Place
Bohemia, NY 11716
(631)589-2065 ext 25
(631)589-2068 fax

LI-COR, Inc.
4421 Superior Street
Lincoln, NE 68504
Telephone: (402) 467-3576
(800) 447-3576
Telefax: (402) 467-2819
http://licor.com/
Radiometers, Data Loggers, Weather Stations

Matrix, Inc.
537 S. 31st St.
Mesa, AZ 85204
Telephone: (480) 832-1380
Radiometers

Medtherm Corporation
P.O. Box 412
Huntsvill, AL 35804
Telephone: (256) 837-2000
Telefax: (256) 837-2001
http://www.medtherm.com
Cavity Radiometers

Middleton Solar
factory 20, 155 Hyde Street
Yarraville, Victoria 3013 Australia
+61-3-9396 1890
+61-3-9689 2384 (Fax)
Radiometers

Ocean Optics, Inc.
830 Douglas Ave.
Dunedin, FL 34698 USA
Telephone: 727.733.2447
Telefax 727.733.3962
http://www.oceanoptics.com
Spectroradiometers

European Sales Office:
Geograaf 24
6921 EW DUIVEN
The Netherlands
+31 (0) 26 319 0500
Fax +31 (0) 26 319 05 05

PH. Schenk GmbH & Co KG
Jedleseer Strasse 59
A-1210 Wien, Austria
Telephone: (+43/1) 271 51 31-0
Telefax: (+43/1) 271 12 28 12
E-Mail: office@schenk.co.at
http://www.schenk.co.at/schenk
Radiometers

Solar Light Company
721 Oak Lane
Philadelphia, PA 19126-3342
Telephone: (215) 927-4206
http://www.solar.com/
Radiometers

Yankee Environmental Systems, Inc.
Montaque Industrial Park
101 Industrial Road
P.O. Box 746
Turners Falls, MA 01376
Telephone: (413) 863-0200
Telefax: (413) 863-0255
http://www.yesinc.com/
Radiometers, Data Systems, Sky Imagers

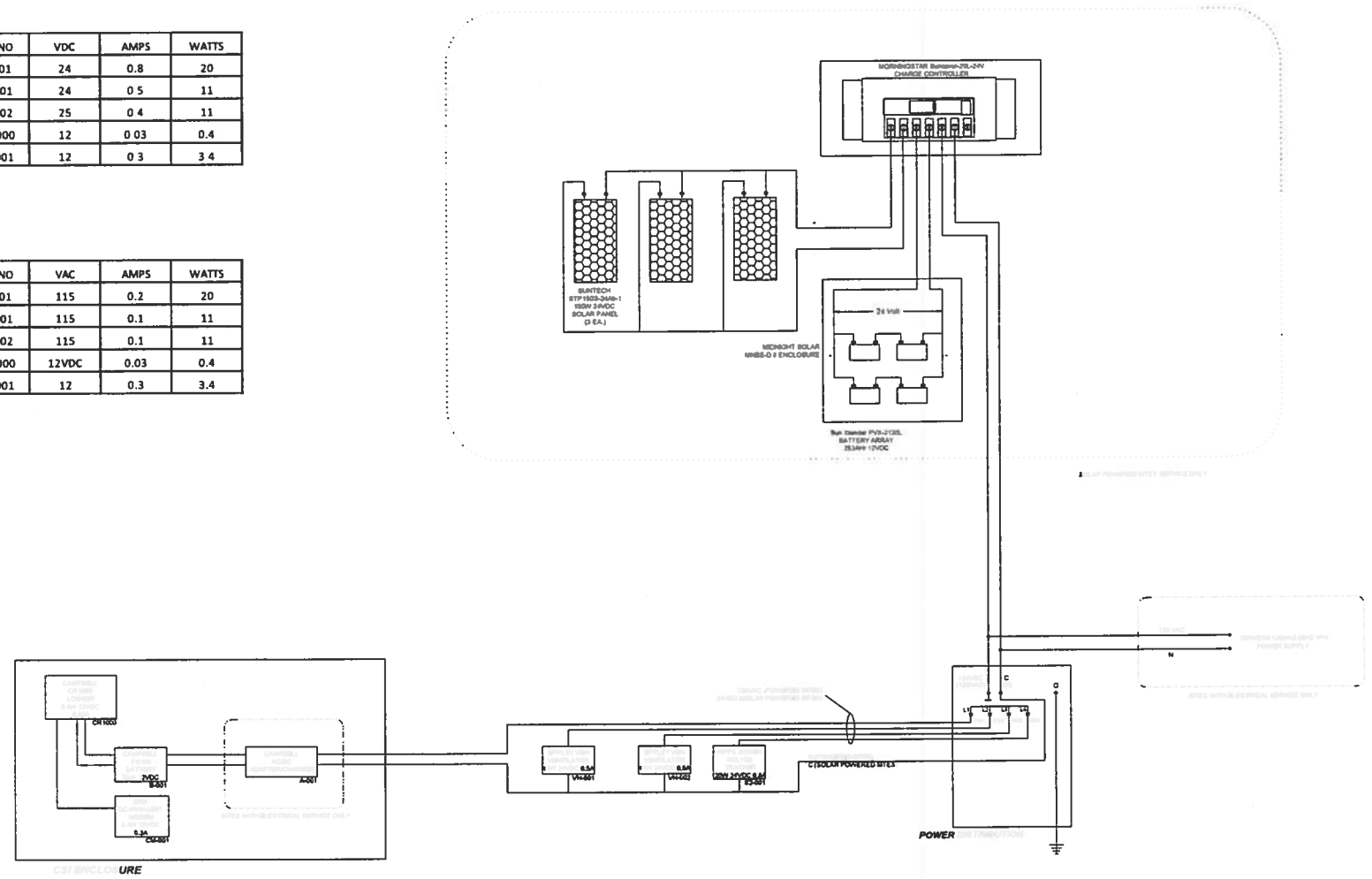
EXHIBIT 6

LOAD TABLE (DC)

DEVICE	TAG NO	VDC	AMPS	WATTS
SOLYS2 TRACKER	S2-001	24	0.8	20
VEN VENTILATOR	VN-001	24	0 5	11
VEN VENTILATOR	VN-002	25	0 4	11
CR1000 LOGGER	CR-1000	12	0 03	0.4
DC-WAN-U301 MODEM	CM-001	12	0 3	3 4

LOAD TABLE (AC)

DEVICE	TAG NO	VAC	AMPS	WATTS
SOLYS2 TRACKER	S2-001	115	0.2	20
VEN VENTILATOR	VN-001	115	0.1	11
VEN VENTILATOR	VN-002	115	0.1	11
CR1000 LOGGER	CR-1000	12VDC	0.03	0.4
DC-WAN-U301 MODEM	CM-001	12	0.3	3.4



CLIENT	AMONIX				
TITLE	SOLAR MEASUREMENT STATION SINGLE LINE DRAWING				
Rev A	Issued for Approval	04/20/2010	GroundWork Renewables, Inc.	SIZE B	DWG NO 1002SL01 REV A
				SCALE NA	SHEET 1/1